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The North American species of *Charadra* Walker, with a revision of the *Charadra pata* (Druce) group (Noctuidae, Pantheinae)

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Abstract

The North American species of the genus *Charadra* Walker are reviewed, and the species of the yellow-hindwing (*C. pata*) group are revised. Four species of the *pata* group are described as new: *Charadra franclemonti* **sp. n.** (Arizona), *C. tapa* **sp. n.** (Arizona), *C. cakulha* **sp. n.** (Mexico), and *C. coyopa* (Mexico) **sp. n.** A new species related to *C. deridens* (previously treated as *C. ingenua*) is described from Arizona / New Mexico / Texas, and *Charadra ingenua* **syn. n.** is synonomized with *Charadra deridens*. The types of *Charadra pata*, *C. oligarchia*, *C. patafex* and *C. ingenua* are illustrated.

Keywords

Charadra, new species, taxonomy, Arizona, New Mexico, Mexico, *Quercus*

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Introduction

The genus *Charadra* Walker as currently understood is comprised of three yellow-hindwinged species (*C. pata* (Druce), *C. oligarchia* Dyar, and *C. patafex* Dyar) and five grey-hindwinged species (*C. deridens* (Guenée), *C. ingenua* J.B. Smith, *C. dispulsa* Morrison, *C. nigracreta* H. Edwards and *C. nitens* Schaus). *Charadra* is restricted to the New World with the greatest species diversity found from the southwestern United States to Central America. The widespread and variable *Charadra deridens* is a well-known species found across most of the continental United States and southern Canada. Based on phenotype and genitalic structure, the genus is arranged into three groups: **1) the *pata* group** (yellow hindwing; male vesica with two simple thorn-like cornuti; clasper not reaching apex of valve; saccus V-shaped; female antevaginal plate bilobed or double pronged; female ductus bursae lacking lateral twisted flanges); includes *C. pata*, *C. oligarchia*, *C. patafex*, and four additional species described herein (*C. franclemonti* sp. n., *C. tapa* sp. n., *C. cakulha* sp. n., *C. coyopa* sp. n.). This group is primarily Mexican – Central American in distribution, with two species reaching southeastern Arizona. **2) the *C. deridens* group** (male cornuti multi-spined, basal cornutus crest-like; clasper reaching apex of valve; saccus broadly U-shaped; female ductus bursae with lateral, ventrally twisted flanges); includes *C. deridens*, *C. moneta* sp. n., *C. dispulsa, C. nitens*, and several undescribed Central American species (BCS, in prep.); as a whole, this group occurs from temperate North America southward to at least Costa Rica. **3) the *nigracreta* group**, with only *C. nigracreta*, is characterized by a simple valve that lacks a clasper; a massive plate-like transtilla; absence of cornuti on the vesica, and presence of a sclerite between the ductus and corpus bursae. These groups may warrant recognition as separate genera, but a review of other pantheine genera, notably the closely related *Colocasia* Ochsenheimer and *Pseudopanthea* McDunnough, is needed before generic limits can be revised and is beyond the scope of this work.

With the exception of Arizona material, the *pata* group is very poorly represented in collections. It appears to be quite diverse in Mexico, where more species will likely be discovered. J. G. Franclemont collected and reared series of the yellow-winged species in southern Arizona in the 1960's; this material consists of two species, neither has an available name. These two Arizona taxa and two new Mexican species are described herein. The western North American taxon *C. ingenua* has been misunderstood and is here synonymized under *C. deridens* syn. n., and a new name is provided for the taxon previously treated as *C. ingenua*.

Methods and materials

Adult genitalia were prepared following the methods detailed by Lafontaine (2004). Cleaned, stained genitalia were stored and examined in 30% ethanol, and slide-mounted in Euparal before being photographed. Molecular variation for some species was assessed based on the 658 base-pair 'barcode' region of the first subunit of the

cytochrome oxidase (*cox1*) gene (Hebert et al. 2003). DNA was extracted from one leg removed from a dried specimen, and processed at the Canadian Centre for DNA Barcoding, Guelph, Ontario. DNA extraction, amplification and sequencing protocols for the Barcode of Life initiative are given in Hebert et al. (2003). Haplotypes of all barcode sequences were compared with phylograms constructed using the neighbour-joining method in PAUP 4.0*b10 (Altivec) (Swofford 2002). Phyletic distances were calculated using the Kimura-2-Parameter (K2P) distance model. Data for molecular voucher specimens, including trace files and photographs, are available at http://barcodinglife.com (project: Lepidoptera of NA Phase II: "*Charadra* revision" under the "Published Projects" tab). Molecular sequences have been submitted to GenBank, but accession numbers were not available at the time of publication.

Institutional collections are abbreviated as follows:

AMNH American Museum of Natural History, New York, New York, USA.

BMNH The Natural History Museum (formerly British Museum [Natural History]), London, United Kingdom.

CNC Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Ontario, Canada.

CUIC Cornell University Insect Collection, Ithaca, New York, USA.

MCZ Museum of Comparative Zoology, Cambridge, Massachusetts, USA.

USNM National Museum of Natural History (formerly United States National Museum), Washington, D.C., USA

UASM University of Alberta Strickland Museum, Edmonton, Alberta, Canada.

Systematics

Charadra Walker

Charadra Walker, 1865: 445.

Type species: *Charadra contigua* Walker, 1865, a junior subjective synonym of *Charadra deridens* (Gueneé).

The generic placement of *Charadra* in relation to other pantheine genera, especially *Pseudopanthea* and *Colocasia*, is in need of review, and more than one genus for the species currently placed in *Charadra* may need to be recognized. The morphology of the genus is quite heterogeneous, but important shared genital characters include the following: apex of uncus with slight to very pronounced medial notch; clasper parallel to ventral valve margin (perpendicular in *Panthea* Hübner) but absent in *C. nitens*; dorsal tegumen lacking process (lobed in *Panthea*, prong-like or flange-like in *Colocasia*); basal costal process absent or highly developed; vesica with two strongly sclerotized cornuti (absent in *C. nitens*); female ductus bursae sclerotized laterally; corpus bursae

lacking signa. Some of the character states treated as autapomorphic for *Panthea* by Fibiger et al. (2009) are also present in *Charadra*, including a dorsally membranous aedeagus and the presence of cornuti on the vesica.

Charadra pata (Druce)
Fig. 1

Trisulodes pata Druce, 1894: 362.
Charadra patens J. B. Smith, 1908; misspelling.
‡*Charadra basiflava* J. B. Smith, 1908; unavailable name.

Type material. *Charadra pata* – Guatemala, Guatemala City. **Holotype** female. BMNH; examined. *Charadra basiflava* – this taxon was listed as a synonym of *pata* by Franclemont & Todd (1983). Todd (1982) questioned the validity of Smith's description, which consists of: "*Trisuloides patens* [sic] Druce, is a *Charadra* which I had named *basiflava* before Dr. Barnes called my attention to the figure in the Biologia (II, 509, p. 96). It has been taken at Palmerlee, Cochise Co., Arizona, and is no doubt a member of our fauna." (Smith 1908). The question is then what Smith meant when he said "had named." Since there is no earlier published mention of *basiflava*, we take this statement to mean that Smith had determined and labeled a specimen as a new species and intended to describe it as *basiflava*. Todd (1982) also concluded this was the most likely meaning of Smith's statement, and designated as lectotype a specimen labeled "Charadra basiflava Smith Type". However, Smith's (1908) statement does not qualify as a valid description under the provision of Article 12 of the ICZN (1999), and *basiflava* is therefore an unavailable name (a conclusion apparently also reached by Poole 1989, as the taxon is not included in his publication). The lectotype designated by Todd (1982) is therefore not a true "type." Even if Smith's description is deemed to be valid, the type specimen is the illustration of *C. pata* in Druce (1894), not the specimen designated as lectotype by Todd (1982).

Diagnosis. The wing markings of the female holotype, the only known specimen of this species, are most similar to those of *C. oligarchia* (only known from two males) and *C. patafex*. Compared to *C. oligarchia*, *C. pata* has a darker grey-brown forewing subterminal area with a contrasting white reniform area, but lacks any outline of a reniform (reniform outlined in *oligarchia*); the orbicular spot is slightly larger and more oblong in *C. oligarchia*. Compared to *C. patafex*, the forewing medial area of *C. pata* is contrastingly darker (concolorous with basal area in *C. patafex*) and the reniform area is white (brownish grey in *C. patafex*); also the hindwing marginal band is darker and narrower in *C. pata* than in *C. patafex*.

Distribution and biology. Known only from the type locality, Guatemala City, Guatemala. Nothing is known of the biology, although the larvae possibly feed on oak, as do those of *C. tapa* and *C. franclemonti*.

Remarks. After studying the type specimen of *C. pata*, we have come to the conclusion that this is not the same species as the Arizona taxon that has gone under this name, and belongs to a southern Mexican / Central American group of species consisting of *C. pata, C. oligarchia, C. cakulha* sp. n. and *coyopa* sp. n., here termed the *oligarchia* subgroup. The holotype female of *C. pata* (Fig. 1) differs from the *tapa* subgroup (*C. franclemonti* sp. n. and *C. tapa* sp. n.) in several key characters, namely the white, almost completely unmarked reniform area (grey and well marked with the usual markings in the *tapa* subgroup), a prominent and thick, well-defined black terminus of the subterminal line near the anal angle characteristic of the *oligarchia* subgroup (thinner, diffuse and poorly defined in *tapa* subgroup), browner tone of the forewing ground colour (grey in *tapa* subgroup). The genitalic structure of the type female of *C. pata* differs from that of both *C. franclemonti* and *C. tapa* in that the antevaginal plate has short lobes, like *C. tapa* (long and prong-like in *C. franclemonti*), but with a more flared-out basal region than in either *C. tapa* or *C. franclemonti*, and the sclerotized lateral margins of the ductus bursae are nearly symmetrical, lacking the pronounced ventral twist of the right lateral margin of *C. tapa* (also nearly symmetrical in *C. franclemonti*).

Based on the brownish ground colour, prominent black mark of the anal angle and whitish reniform area, we place *C. pata* in the *oligarchia* subgroup. The lack of associated specimens of corresponding sexes is problematic, as it leaves the possibility that *C. pata* is the same species as *C. oligarchia, C. patafex, C. cakulha* or *C. coyopa*; a correlation in the structure of the male and female genitalia in this group is of some help, since asymmetrical placement or size of the male vesica cornuti corresponds to asymmetry in the shape and sclerotization of the ductus bursa (where the cornuti are presumably positioned during copulation: for example, in *C. tapa,* males have both cornuti positioned on the right, while females have a more heavily sclerotized, twisted right lateral margin of the ductus bursae). The nearly symmetrical ductus bursae of *C. pata* suggests a similar symmetrical placement and size of male cornuti, which would rule out *C. oligarchia* and *C. patafex*, (Figs 2, 3), a conclusion that also is supported by differences in wing markings. *C. cakulha* has both symmetrical placement and size of cornuti (Fig. 24), but differs markedly in wing markings (Fig. 7), as does *C. coyopa* (Fig. 10).

Charadra patafex Dyar
Fig. 2

Charadra patafex Dyar, 1916: 19.

Type material. Type locality: "Guerrero Mill, Hidalgo, Mexico, 9000 feet" Holotype ♂. USNM; examined.

Diagnosis. The relatively uniform grayish-brown forewing pattern is similar to that of *C. tapa* and *C. franclemonti*, but the latter two species lack the bold, thick anal

terminus of the subterminal line. The huge costal process of the male valve are unique in the yellow-winged *Charadra* species.

Distribution and biology. Known only from the type locality of Guerrero Mill, State of Hidalgo, Mexico at 9000 feet elevation. Possibly associated with dry oak woodlands at higher elevations, as are *C. tapa* and *C. franclemonti*.

Charadra oligarchia Dyar
Figs 3, 13

Charadra oligarchia Dyar, 1916: 19.

Type material. Type locality: "Guerrero Mill, Hidalgo, Mexico, 9000 feet" Holotype ♂. USNM; examined.

Diagnosis. Superficially similar to *C. cakulha* and *C. pata*. The contrastingly pale outer third of the forewing is similar only to *C. cakulha*, but *C. oligarchia* is darker overall; internally, the male vesica has the two cornuti placed at the base of the vesica, one massive, one small, whereas *C. cakulha* has two lateral, symmetrical cornuti that are fused to the aedeagus. See also 'Diagnosis" of *C. pata*.

Distribution and biology. Known only from Guerrero Mill, Mexico. Possibly associated with dry oak woodlands at higher elevations, as in *C. tapa* and *C. franclemonti*.

Remarks. As discussed in the diagnosis of *C. pata*, *C. oligarchia* and *C. pata* may be the same species, but lack of specimens of each taxon of the corresponding sex prevents further comparison; however, the *pata* holotype differs slightly in wing markings, and the type localities of the two species are in different mountain ranges separated by several hundred kilometers, so we treat both as distinct taxa until more study material becomes available.

Charadra franclemonti **Anweiler & Schmidt, sp. n.**
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Figs 5, 6, 23, 30

Type material. Holotype ♂ – UNITED STATES. "USA: Cochise Co. [County] Chirica / hua Mtns [Mountains]. Pinery Cyn [Canyon] cmpgd [campground] / 31.93N 109.27W 6500' / 5-VIII-08 pine/oak/riparian / MV lt. C. Schmidt & B.Walsh."; "HOLOTYPE / *Charadra franclemonti* / Anweiler & Schmidt" [red label]. Deposited in CNC. **Paratypes** – 22 ♂, 5 ♀ [CNC, CUIC, USNM, UASM]. United States: Arizona: same data as holotype (18 ♂, 3 ♀); Cochise Co., Chiricahua Mtns, East Turkey Creek 6400', 7 Aug. 1967, J. G. Franclemont (1 ♀); Cochise Co., Chiricahua Mtns., Cave Creek Canyon, 5400', 21 Sept. 1966, J. G. Franclemont, reared *ex ova*, on *Quercus gambelii* (1 ♂); Cochise Co., Chiricahua Mtns, Onion Saddle 7600', 17 July 1966, J.G. Franclemont (1 ♂); Santa Cruz County, Santa Rita Mtns, Madera Canyon 5800'; Sierra Vista, 9 Sept.1967, R. F. Sternitzky (1 ♂), 13 Jul 1960, J. G. Franclemont (1 ♀);

Coconino Co., 6 1/3 mi. ESE Flagstaff, Walnut Canyon., 6500', 24 July 1965, J. G. Franclemont (1 ♂).

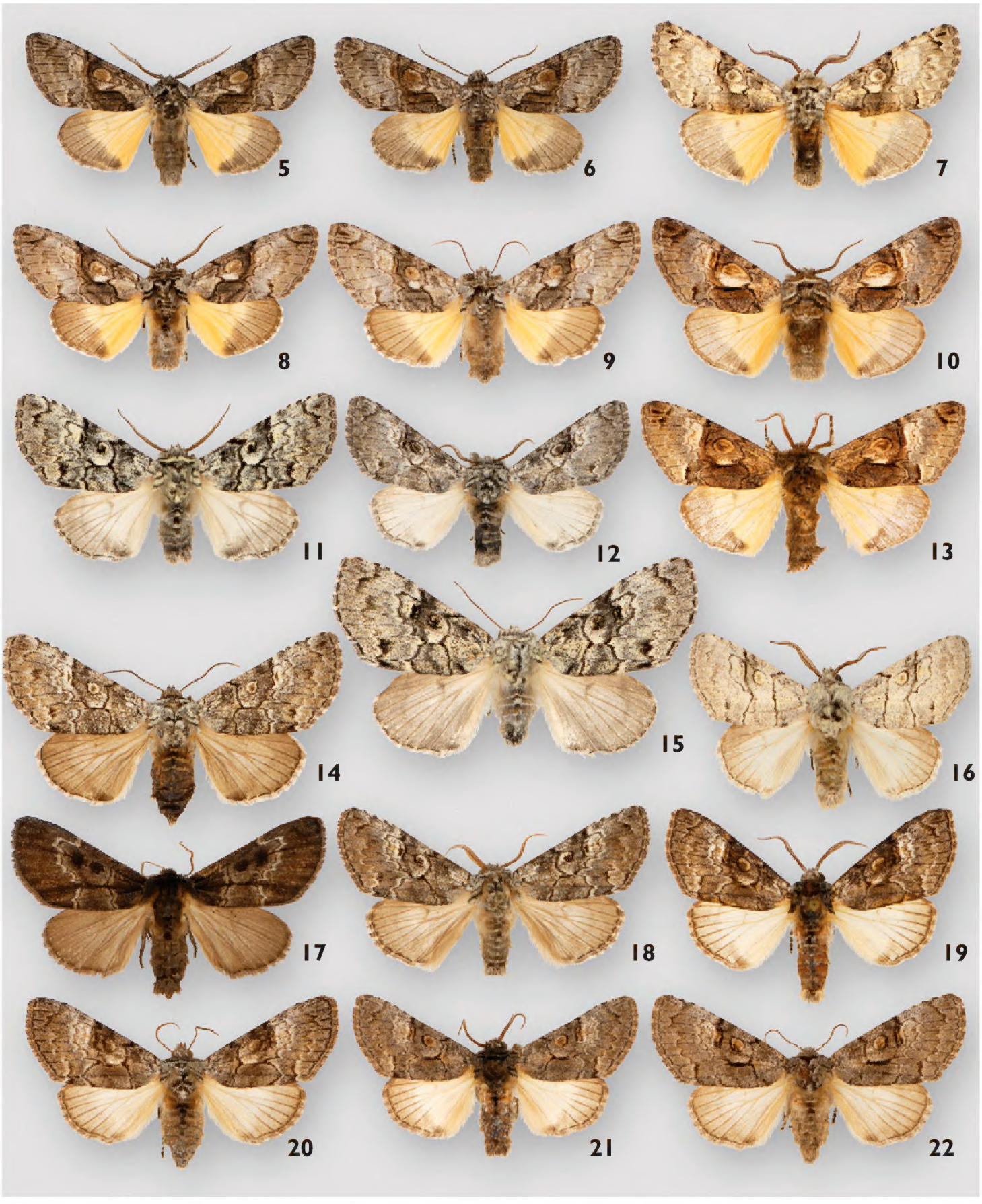
Etymology. We name this species after the late John G. Franclemont who collected and reared this species and recognized that there were two distinct species in southern Arizona.

Diagnosis. Superficially very similar to *Charadra tapa*, but can be separated by the forewing pattern and in particular by genital characters in both sexes. The outer half of the forewing in both sexes is darker and more patterned, with the outer forewing more even and paler grey in *C. franclemonti* than in *C. tapa*. Females can be separated without dissection by brushing the underside of the terminus of the abdomen and examining the sterigma and in particular the lamella antevaginalis, which extends caudally in two long prongs in *C. franclemonti* (often visible with the naked eye); in *C. tapa* these prongs are reduced to two blunt lobes. In males, the vesica of *C. franclemonti*, when inflated, expands into a pouch as it exits the aedeagus, and the two cornuti are on opposite sides of the vesica; in *C. tapa* the vesica is not significantly expanded where it exits the aedeagus and the two cornuti are together on one side. The valves of *C. franclemonti* are more truncated and squared off than those of *C. tapa*, which are slightly more produced and tapered. Although there is some overlap in flight periods, *C. franclemonti* primarily flies in July and August, whereas *C. tapa* flies in September and October.

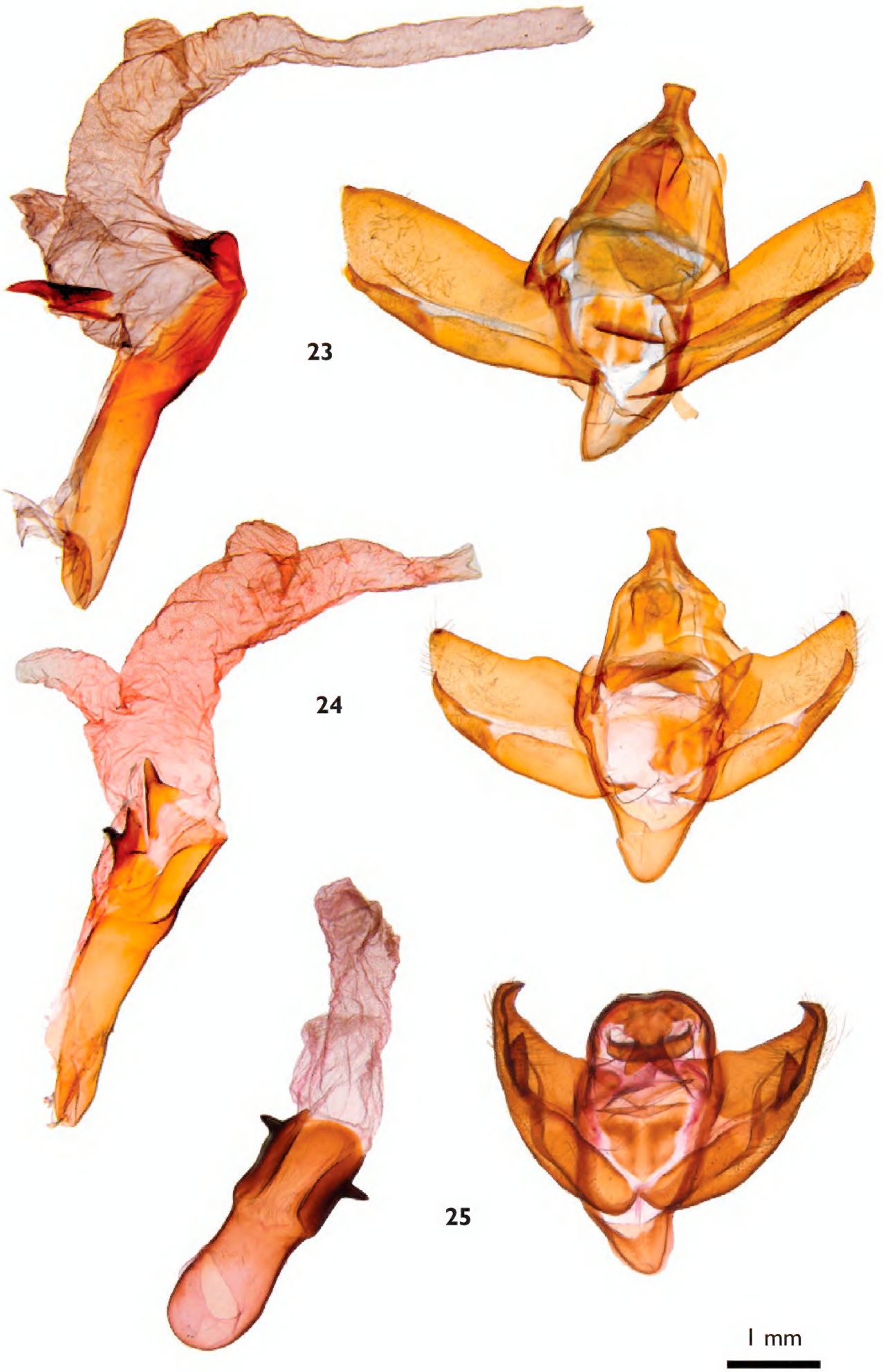
Description. Sexes externally alike, except females slightly larger than males. FW length averaging 18 mm in males, 19 mm in females. *Head* – palps short, covered in stiff grey, black and white hair-like scales; proboscis well developed; eyes large, globular; frons with short grey and black hair; antennae broadly bipectinate, with longest rami about 7 times as long as width of shaft. *Thorax* – clothed in long dark-grey, black, and white scales; tegulae mostly white anteriorly, black and grey banded on posterior; Forewing dark grey with a brown-black medial band. Basal area a mix of black and white scales, appearing light grey, with white scales bleeding into medial area below orbicular producing a small pale streak. Antemedial line narrow, black, erratic and dragged outward below orbicular to meet or almost meet postmedial line midway. Orbicular spot prominent, oval, filled with dark blackish-brown scales and narrowly outlined in black. Medial band broad, brownish black, narrower on upper side and extending to upper margin above orbicular, but extending almost to wing base on lower half. Postmedial line black, narrow, erratic, pulled inward to meet or almost meet antemedial line midway. Postmedial line erratic, poorly defined, bordered outwardly with white scales that expand into a diffuse whitish-grey reniform spot. Subterminal line poorly defined by dark scales, except more prominently lined with black at lower margin of wing and where it bends basad before meeting upper margin of wing. A diffuse patch of white scales at anal angle. Terminal line narrow, black, broken at veins. Fringe dark grey and black, faintly checked with lighter grey at veins. Veins beyond medial area narrowly lined with black. Hindwing pale yellow with an orange tint on basal half, sharply divided from grey black outer half. Fringe grey on inner half, white on outer half and lightly checkered with black between veins. *Abdomen* – clothed in lead grey hair-like scales mixed with numerous white scales at terminus, with a series

Figures 1–4. Adults and genitalia of *Charadra* type specimens. **1** *C. pata*, holotype, Guatemala City, Guatemala **2** *C. patafex*, holotype, Guerrero Mill, Hidalgo, Mexico **3** *C. oligarchia*, holotype, Guerrero Mill, Hidalgo, Mexico **4** *C. ingenua*, lectotype, Durango, Colorado.

of 3–4 small dark-grey tufts midway along dorsal centerline. Legs grey, banded with black at the joints. *Male genitalia* (Fig. 23) – Valves simple, subquadrate apically with a slightly pointed dorsal apex; costal process absent; clasper a simple scoop-shaped process about 1/10 length of dorsal valve margin, with broad surface directed dorso-cephalad; sacculus unmodified; uncus with a wide base and narrowest medially, apex broadly



Figures 5–22. Adult habitus of *Charadra* species. **5** *C. franclemonti*, ♂ holotype, Pinery Cyn., Chiricahua Mtns., AZ **6** *C. franclemonti*, ♀ paratype, Pinery Cyn., Chiricahua Mtns., AZ **7** *C. cakulha*, ♂ holotype, San Cristobal de las Casas, Chiapas, Mexico **8** *C. tapa*, ♂ paratype, Madera Cyn., Santa Rita Mtns., AZ **9** *C. tapa*, ♀ paratype, Madera Cyn., Santa Rita Mtns., AZ **10** *C. coyopa*, ♂ holotype, Distrito Federal, Mexico **11** *C. deridens*, ♂, Edmunston, NB **12** *C. deridens*, ♂, Garfield Co., CO **13** *C. oligarchia*, ♂, Guerrero, Mexico **14** *C. deridens*, ♀, Morehead, KY **15** *C. deridens*, ♀, Edmunston, NB **16** *C.* dispulsa, ♂, Georgetown, TX **17** *C. deridens*, ♀, Mt. Pocono, PA **18** *C. deridens*, ♂, Morehead, KY **19** *C. moneta*, ♂ holotype, Walnut Cyn., Coconino Co., AZ **20** *C. moneta*, ♀ paratype, Walnut Cyn., Coconino Co., AZ **21** *C. moneta*, ♂, Big Bend National Park, Brewster Co., TX **22** *C. moneta*, ♀, Big Bend National Park, Brewster Co., TX.



Figures 23–25. Male genitalia of *Charadra* species. **23** *C. franclemonti* paratype, Pinery Cyn., Chiricahua Mtns., AZ **24** *C. tapa* paratype, Ash Cyn., Huachuca Mtns., AZ **25** *C. cakulha* holotype, San Cristobal de las Casas, Chiapas, Mexico.

Figures 26–29. Male genitalia of *Charadra* species. **26** *C. coyopa* holotype, Distrito Federal, Mexico **27** *C. deridens*, Morehead, KY **28** *C. moneta* paratype, Walnut Cyn., Coconino Co., AZ **29** *C. dispulsa*, Sinton, TX.

squared with a medial notch giving a slightly bifid appearance; tegumen greatly expanded dorsally; saccus quadrate with broad U-shaped medial dorsal notch; aedeagus 5x longer than diameter, with a very wide, dorsally directed opening to vesica, opening about 1/3 total length of aedeagus; bulbous base of vesica directed at about 90 degrees to aedeagus; vesica base with two large, equal-sized, thorn-like cornuti positioned opposite each other, one ventral and one dorsal; one medial and one distal diverticulum of similar size, oriented dorsally. *Female genitalia* (Fig. 30) – Papillae anales blunt with very slight medial tip; antevaginal plate (caudal extension of sternum VII) prominent, slightly longer than length of sternum VIII and with two prongs extending beyond caudal margin of sternum VIII; ductus bursae heavily sclerotized and short, slightly wider than long, flattened dorso-ventrally and asymmetrical due to a ventral twist of right lateral margin; corpus bursae asymmetrically heart-shaped, membranous, finely spiculate under high magnification; ductus seminalis exiting caudally on left chamber of corpus bursae.

Distribution and biology. *Charadra franclemonti* ranges from central Arizona (Coconino Co.) southward to at least Durango, Mexico. The flight period is from mid-July into August. Captive larvae were reared on *Quercus gambelii* Nuttal.

Remarks. One slightly larger, darker male specimen from El Salto, Durango, Mexico is provisionally treated as this species since it is indistinguishable in genital structure, but is excluded from the type series. Although this species and *C. tapa* have both been treated and identified as *C. pata*, neither *C. tapa* nor *C. franclemonti* is closely related to *C. pata*; see 'Remarks' under *C. tapa*, below.

Five specimens from the type locality exhibited a single barcode haplotype that was more than 5% divergent from those of *C. deridens*, *C. moneta*, and *C. dispulsa*; no barcodes for any other *pata* group species were available for comparison.

Charadra tapa Schmidt & Anweiler, sp. n.

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Figs 8, 9, 24, 31

Type material. Holotype ♂ – UNITED STATES. "AZ; Cochise Co. / Huachuca Mts, 5354 Ash / Cyn [Canyon] Rd. 0.5miW [0.5 miles west of] Hwy [Highway] 92 / 15.IX.1992 5100' / N. McFarland UV light"; "HOLOTYPE / *Charadra tapa* / Schmidt & Anweiler" [red label]. Deposited in CNC. **Paratypes** – 21 ♂, 9 ♀ [CNC, CUIC, USNM, UASM]. Same data as holotype (all reared ex ova on *Quercus gambelii*), 5 Oct 1959 (1 ♂); 15 Aug 1965 (1 ♂); 27 Aug. 1965 (1 ♀); United States: Arizona: Cochise Co., Huachuca Mountains, Ramsey Canyon., R. F. Sternitzky, 2 Oct. 1967 (3 ♂, 1 ♀), 13 Sept. 1967 (1 ♂), 25 Sep 1967 (1 ♂), 29 Oct. 1967 (3 ♂, 1♀), 24 Sept. 1967 (1 ♀); Cochise Co., Huachuca Mountains, Carr Canyon., R. F. Sternitzky, 28 Sep 1967, (1♀), 24 Sep 1967 (3 ♂), 28 Sep 1967 (2 ♂); Cochise Co., Sierra Vista, F. Sternitzky, 8 Sept. 1967, (1 ♂), 25 Sept. 1967 (1 ♂), 18 Sep 1966 (1 ♀); Cochise Co., Huachuca Mtns, Garden Cyn., F. Sternitzky, 9 Oct. 1967, (1 ♂); Cochise Co.,

Huachuca Mtns, 5354 Ash Canyon. Rd. 0.5 mi W Hwy. 92, 15 Sept. 1992, 5100', N. McFarland, (1 ♂), 22 Sep 1992 (1 ♀), 24 Sep 1992 (1 ♂), 21 Sep 1992 (1 ♂); Cochise Co., Chiracahua Mtns, Southwestern Research Station, 21 May 1960, C.W. Kirkwood (1 ♀); Santa Cruz Co., Santa Rita Mtns, Madera Canyon, 4880', 1 Oct. 1959, (1 ♀), 14 Aug 1965 (1 ♂), J.G. Franclemont.

Etymology. The name *tapa* is an anagram of *pata*.

Diagnosis. Most similar to *C. franclemonti*; see diagnosis under that species.

Description. Sexes externally alike, except females slightly larger than males. FW length averages 18 mm in males, 19 mm in females. *Head, thorax, abdomen* – as for *C. franclemonti*, with following differences in wing markings: Forewings slightly paler grey overall, particularly distal third; medial dark area slightly paler; hindwing with slightly paler yellowish base, dark marginal band on average slightly wider than in *C. franclemonti*. *Male genitalia* (Fig. 24) – structurally very similar to that of *C. franclemonti*, with following differences: valve tip slightly more triangular (more squared in *C. franclemonti*); base of vesica with two large, thorn-like cornuti positioned adjacent to each other on left-sublateral area. *Female genitalia* (Fig. 31) – as in *C. franclemonti*, with following differences: antevaginal plate with broad U-shaped medial notch and two short, broadly-rounded triangular lobes, not extending beyond margin of sternum; ductus bursae with a more pronounced ventral twist of right lateral margin.

Distribution and biology. The known distribution of *C. tapa* is limited to the Chiricahua, Huachuca, and Santa Rita Mountains of southeastern Arizona, although the species probably occurs in adjacent parts of Mexico. The main flight period is from September to October; a single specimen from early May indicates there may be spring flight. Larvae have been reared on Gambel Oak (*Quercus gambelii*).

Remarks. Although previously treated as such, neither *C. tapa* nor *C. franclemonti* is referable to *C. pata*, as pointed out in the 'remarks' section of *C. pata.*

Charadra cakulha Schmidt & Anweiler, sp. n.

urn:lsid:zoobank.org:act:3FCD51C4-A812-49D5-B653-56922696F08B

Figs 7, 25

Type material. Holotype ♂ – MEXICO: "MEX., San Cristobal / de Las Casas, Chi[apa]s. / June 17 1969 / A. Mutuura"; "HOLOTYPE / *Charadra cakulha* / Schmidt & Anweiler" [red label]. CNC. Paratypes – same data as holotype, (1♂). CNC.

Etymology. A deity from Mayan mythology, Cakulha is the ruler of the lesser lightning bolts, and brother of Coyopa. It is a noun in apposition.

Diagnosis. Externally recognizable by the very pale greyish-white outer third of the forewing and thorax, unique among the *pata* group. In addition to the wing markings, *C. cakulha* is distinguishable from the similar *C. oligarchia* by the lateral, symmetrical cornuti that are fused to the aedeagus (in *C. oligarchia* they are at the base of the vesica with one cornutus massive and one small).

Figures 30–34. Female genitalia of *Charadra* species. **30** *C. franclemonti* paratype, Madera Cyn., Santa Rita Mtns., AZ **31** *C. tapa* paratype, Ramsey Cyn., Huachuca Mtns., AZ **32** *C. moneta* paratype, Walnut Cyn., Coconino Co., AZ **33** *C. deridens*, Morehead, KY **34** *C. dispulsa*, Sinton, TX.

Description. Female unknown. Forewing length 19.7 mm. *Head, thorax and abdomen* – as in *C. franclemonti*, differing in the following characters: vestiture much paler grey, nearly white; thorax with margin of tegulae and patagia bordered with black scales. Forewing light grey, distal third powdery whitish grey; reniform spot not discernible, reniform area entirely whitish; orbicular broadly oval, whitish with brown diffuse central area; subterminal line poorly defined medially by irregular white line, black scales at costal and anal margin, expanded to a thick, prominent line at anal margin. *Male genitalia* (Fig. 25) – Valves simple, subquadrate apically with a strongly incurved, scoop-shaped dorsocaudal apex; costal process absent; clasper a simple scoop-shaped process about 1/6 length of dorsal valve margin, with broad surface directed dorso-

cephalad; sacculus unmodified; uncus strongly constricted medially and apex bifid, with an overall Y-shaped appearance; tegumen expanded dorsally; saccus V-shaped; juxta triangular; subscaphium strongly sclerotized; aedeagus 3 × longer than wide, with a very wide, dorsally directed opening to vesica, opening about 1/3 total length of aedeagus; vesica directed at about 90 degrees to aedeagus; cornuti usually placed on base of vesica and fused laterally to aedeagus, so aedeagus armed distolaterally with two stout, laterally projecting spines, left one placed slightly more apically; one medial and one distal diverticulum of similar size, oriented dorsally.

Distribution and biology. Known only from the two specimens of the type series, collected in mid-June at San Cristobal de las Casas, Chiapas, Mexico.

***Charadra coyopa* Schmidt & Anweiler, sp. n.**
urn:lsid:zoobank.org:act:C3A359C5-34C7-4A8A-BB1D-B6DFCD099CE8
Figs 10, 26

Type material. Holotype ♂ – MEXICO: "10268 / Mexico, D. F. [Distrito Federal, Mexico City] / 17 – I – 1946" [white handwritten label]; "T. Escalante / Collection / through / A. C. Allyn, 1974" [white typed label]; "Photographed / by JDG 1001" [pink typed label]; "HOLOTYPE / C*haradra coyopa* / Schmidt & Anweiler" [red label]. USNM.

Etymology. The name is derived from Mayan mythology. Coyopa is the ruler of the sound of thunder, and the brother of Cakulha. It is a noun in apposition.

Diagnosis. *Charadra coyopa* is superficially most similar to *C. oligarchia*, but with an oblong rather than a round orbicular, and with a prominent pale patch (absent in *C. oligarchia*) below the orbicular. The male vesica has a single massive cornutus, unique in *Charadra*.

Description. Female unknown; forewing length 18.9 mm. *Head, thorax and abdomen* – as for *C. franclemonti*, differing in the following characters: prothoracic collar pale brown with a whitish-grey border; vestiture paler grey brown; forewings with basal two-thirds grey brown, distal third (beyond postmedial line) grey, terminal area grey brown; reniform spot yellowish white with oblong, hollow-centered medial line; orbicular elongate oval, yellowish white with diffuse brown central scales; postmedial line distinct and serrate at veins; subterminal line diffuse and brown, expanded to a thick black line at costal and anal margins, two apical black dashes along veins. *Male genitalia* (Fig. 24) – Valves simple, subquadrate apically with an incurved, scoop-shaped dorso-caudal apex, which appears irregular and somewhat spinulose; costal process absent; clasper a simple scoop-shaped process about 1/6 length of dorsal valve margin, with broad surface directed dorso-cephalad; sacculus unmodified; uncus strongly constricted medially and apex bifid, Y-shaped; tegumen expanded dorsally; saccus V-shaped; juxta triangular; subscaphium sclerotized and minutely scobinate; aedeagus 4.5 × longer than wide, with a very wide, dorsally directed opening to vesica, opening about 1/3 total length of aedeagus; vesica directed at about 90 degrees to aedeagus; a single, massive rose-thorn like cornutus positioned near base on left side, directed towards vesica base.

Distribution and biology. Known only from the holotype specimen from the Mexico City area. The collection date indicates a flight period in January.

Charadra deridens (Guenée)
Figs 11, 12, 14, 15, 17, 18, 27, 33

Phalaena Bombyx corylina Martyn, 1797: pl. 26 fig. 70; **syn. n., nomen oblitum.**
Diphthera deridens Guenée, 1852 in Boisduval & Guenée 1852: 35 pl. 3, fig. 8.
Acronycta circulifera Walker, 1857: 709.
Charadra contigua Walker, 1865: 446.
Charadra ingenua J. B. Smith, 1906: 10; **syn. n.**
Charadra sudena J. B. Smith, 1908: 80.
‡*Charadra deridens* ab. *nigrosuffusa* Strand, [1917]: 46; **unavailable**
Charadra deridens form *fumosa* Draudt, in Seitz 1924: 19.

Type material. *Phalaena Bombyx corylina* – Type locality: [USA:] Georgia. Unstated number of types [unknown]. **Note** – this name was transferred to the genus *Charadra* by Poole (1989) and therein stated to probably be conspecific with *C. deridens*. *Bombyx corylina* has otherwise not appeared in the published literature in the past 200 years, nor since Poole's (1989) mention. To preserve the name *Charadra deridens* for a well-known North American species, which has appeared in many publications since its description, we treat *Bombyx corylina* Martyn as a *nomen oblitum* and *Diphtera deridens* Guenée as a *nomen protectum* under the provisions of Article 23.9.2 of the International Code of Zoological Nomenclature (1999). The suppression of the name *corylina* requires that 1) it has not been used as a valid name after 1899 (the usage of the name in Poole (1989) must not be taken into account under the provisions of Article 23.9.6), and 2) the junior synonym (*deridens*) has been used as the presumed valid name, in at least 25 works, published by at least 10 authors in the immediately preceding 50 years and encompassing a span of not less than 10 years. A search of the Zoological Record indicates that both provisions are met.

Diphthera deridens – Type locality: North America.

Acronycta circulifera – [USA:] East Florida. Female holotype. BMNH; photograph examined.

Charadra contigua – [USA:] Georgia. Male holotype. BMNH; photograph examined.

Charadra ingenua – Type locality: [USA:] Durango, Colorado. Male lectotype (Fig. 4) designated by Todd (1982). AMNH; examined. **Note** – *Charadra ingenua* has been a "ghost species," rarely mentioned in the literature and with few specimens in collections. The lectotype is a specimen typical of eastern Colorado *C. deridens* populations, which are slightly smaller and have less contrastingly marked forewings and paler hindwings than eastern North American *C. deridens*. Examination of specimens from western Colorado matching the type of *C. ingenua* are not distinguishable in genital characters from *C. deridens*, so we place *C. ingenua* syn. n. in synonymy with *C. deri-*

dens. Specimens from the Guadalupe Mountains of west Texas reported as *C. ingenua* by Blanchard and Franclemont (1981) are *C. moneta* sp. n. (see below).

Charadra sudena – Type locality: [USA:] Florida, Miami. Male lectotype designated by Todd (1982). AMNH; photograph examined.

Charadra deridens ab. *nigrosuffusa* – an unavailable infrasubspecific name.

Charadra deridens form *fumosa* – Type locality: None given [unknown].

Diagnosis. *C. deridens* can be identified by it being the only *Charadra* species throughout its range, and is characterized by the typically monochromatic colouring of the forewing (lacking brown shades), and the black scaling in the orbicular spot (diffuse and brownish in *C. moneta*). *Charadra deridens* may prove to be sympatric with *C. moneta* in New Mexico and western Texas, but the two can be distinguished by the more contrasting 'pupil' of the orbicular spot in *deridens*, and the white-grey rather than brownish forewing colour of *moneta*, as well as by the genital differences presented in the diagnosis of *C. moneta*.

Distribution and biology. Widely distributed, from Nova Scotia to British Columbia (not yet recorded from Alberta), south to Florida, Texas (Knudson and Bordelon 2004) and northeastern New Mexico (Raton, Colfax Co.). The larva, illustrated by Wagner (2005), feeds primarily on beech, oak, and white birch.

Remarks. Although quite consistent in appearance within a given geographic region, there is a moderate amount of variation in phenotypes across its range, and a melanic form (Fig. 16) occurs in the northeastern part of its range (Klots 1968). The palest specimens are from Atlantic Canada (Fig. 11, 15), particularly Nova Scotia. Kentucky specimens are on average smaller with a slight brown cast and reduced white scaling (Figs 14, 18), whereas Colorado specimens are paler overall with less contrasting forewing markings (*ingenua*, Fig. 12).

Four specimens of *C. deridens* from Ontario and Kansas expressed three haplotypes, differing by less than 1%, and at least 2.5% divergent from three *C. moneta* samples.

***Charadra moneta* Schmidt & Anweiler, sp. n.**

urn:lsid:zoobank.org:act:3650C4F0-1233-44D0-977B-1FC79CC18A14

Figs 19–22, 28, 32

Type material. Holotype ♂ – UNITED STATES: "Walnut Canyon 6500' / 6-1/3 mi EESE Flagstaff / Coconino co., Arizona / 12 September 1965 / J. G. Franclemont"; "HOLOTYPE / *Charadra moneta* / Schmidt & Anweiler" [red label]. CUIC. Paratypes – (33 ♂, 33 ♀) CNC, CUIC, USNM. Arizona: same data as holotype, 9–18 Sep 1965 (27 ♂, 13 ♀); 15 May – 22 June 1966 (6 ♂, 14 ♀); 17 Dec. 1965 (1 ♀); 30 Jan. 1966 (1 ♀); 20 Feb. 1966 (1 ♀); 17 Apr. 1966 (1 ♀); 29 Apr. 1966 (1 ♀). Arizona, Apache Co., 3 mi. S Alpine, 15 June 1966, R.F. Sternitzky (1 ♀).

Etymology. During a discussion regarding the distinctness of this taxon compared to *C. deridens*, BCS bet GGA ten dollars that the DNA barcodes of *C. moneta* and *C. deridens* would be more than 1% divergent. *Moneta* is the Latin term for money.

Diagnosis. *Charadra moneta* is most likely to be confused with *C. deridens*, from which it differs externally in the overall warm brown tones of the fore- and hindwing (the forewing having more the appearance of the *pata* group), compared to the grey, black and white colour of *C. deridens*. The orbicular spot in *moneta* has a brownish, diffuse pupil, whereas that of *C. deridens* almost invariably has a well-defined central black pupil. Internally, the subdorsal cornuti of the male vesica lacks subapical spines (two or three spines in *C. deridens*), and the vesica differs in shape. The base of the vesica is smaller, with the diameter 1.3 × that of the aedeagus apex, compared to nearly 2 × the diameter in *C. deridens*. The basal diverticulum of the vesica has a constricted base in *C. moneta*, but is very broad-based in *C. deridens*. The barcode fragment of the COI gene is about 2.5% divergent between *C. moneta* (New Mexico) and *C. deridens* (Colorado and various eastern North American localities).

Description. Sexes externally alike, except females slightly larger than males. FW length averaging 18 mm in males, 19 mm in females. *Head* – palps short, covered in stiff grey, black and white hair-like scales; proboscis well developed; eyes large, globular; frons with short grey and black hair; male antenna broadly bipectinate, with longest rami about seven times as long as width of shaft; female antennae biserrate. *Thorax* – clothed in long light grey, black and brown scales; forewing dark brown, sometimes with a poorly defined slightly darker medial area; antemedial and postmedial black lines well defined to nearly obsolete, often joined medially by a dark lateral streak; area around reniform spot and below orbicular spot with pale-grey or whitish-gray scales; reniform whitish, indistinct, with a diffuse pale-brown infill; orbicular round to slightly oblong, pale grey with diffuse brown infill; subterminal line poorly defined with dark scales, except more prominently lined with black where it meets lower margin and where it bends basad before meeting upper margin; terminal line narrow, black, broken at veins; fringe dark grey and black, faintly checked with lighter grey at veins; hindwing pale fuscous, almost white in basal half with a slightly darker marginal area in distal third; veins darkly scaled along outer half of wing; fringe grey on inner half, white on outer and lightly checkered with black between veins. *Abdomen* – clothed in lead grey hair-like scales mixed with numerous white scales at terminus, with a series of three small dark-grey tufts midway along dorsal centerline; legs grey, banded with black at joints. *Male genitalia* (Fig. 28) – Valve simple and relatively short, lobate; apical and dorsal margin slightly convex; costal process long and sickle shaped, extending to valve apex, with fine, apically directed spinules; clasper club shaped with a caudoventrally directed, pyriform apex, extending to valve apex; sacculus unmodified; uncus slightly constricted medially, apex bluntly rounded with a slight medial notch; tegumen narrow and band-like dorsally; saccus broadly U-shaped; juxta Y-shaped with a triangular base; aedeagus 4 × longer than wide, with a very wide, dorso-caudally directed opening to vesica, opening about 1/3 total length of aedeagus; bulbous base of vesica orientedt about 90 degrees to aedeagus; base of vesica with two large cornuti on right side, a subdorsal thorn-like cornutus directed basad, terminating in two or three irregular points; second cornutus situated laterad, consisting of a low, multi-spined crest; one medial and one distal diverticulum, both bulbous, distal one slightly smaller, oriented dorsad.

Female genitalia (Fig. 32) – Papillae anales blunt, unmodified; antevaginal plate with broad U-shaped medial notch, proximal margin with a pair of shallow, lightly sclerotized pockets; laterally with ventrally curved, flange-like pockets; ductus short, lightly sclerotized;; corpus bursae pyriform with a broad triangular diverticulum dorsally near junction of ductus bursae; ductus seminalis exiting caudo-ventrally.

Distribution and biology. Recorded from central and eastern Arizona (Coconino and Apache Cos.), the San Mateo Mountains of New Mexico, the Guadalupe Mountains of New Mexico and Texas, and the Big Bend region of Texas; south to the Sierra Madre in Nuevo Leon, northern Mexico. Collection dates range from March to June (Arizona, Texas, and New Mexico) and September (Mexico), possibly indicating two or more broods. Much of the type series was reared on *Quercus gambelii*.

Remarks. Specimens from New Mexico and Texas have a more smoothly-marked forewing and a less contrasting hindwing marginal band than those from Arizona, but are indistinguishable internally; the type series is therefore restricted to Arizona specimens.

Three barcoded specimens from NM exhibited a single haplotype, at least 2.5% divergent from the sampled *C. deridens* haplotypes.

Charadra dispulsa **Morrison**

Figs 16, 29, 34

Charadra dispulsa Morrison, 1875: 214.

Type material. Type locality: [USA:] "Waco, Texas." Holotype female. MCZ; photograph examined, available at http://insects.oeb.harvard.edu/MCZ/.

Diagnosis. A relatively small, pale silvery-grey species with few forewing markings that are largely confined to a narrow, black antemedial line and a prominent partial medial band from the costa to mid wing. The small size, pale colour, reduced markings, lack of central orbicular black scales, and black medial dash connecting the AM and PM lines allow this species to easily be distinguished.

Distribution and biology. Occurs from Texas southward and westward to at least San Luis Potosi, Mexico. Collection records range from March through May and July for southern Texas. Nothing is known of the larval stages or food plants, but larvae are possibly oak feeders.

Remarks. Barcode sequence for one specimen of *C. dispulsa* was available, which differed about 3.5% from *C. deridens*, 4% from *C. moneta*, and 6% from *C. franclemonti*.

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